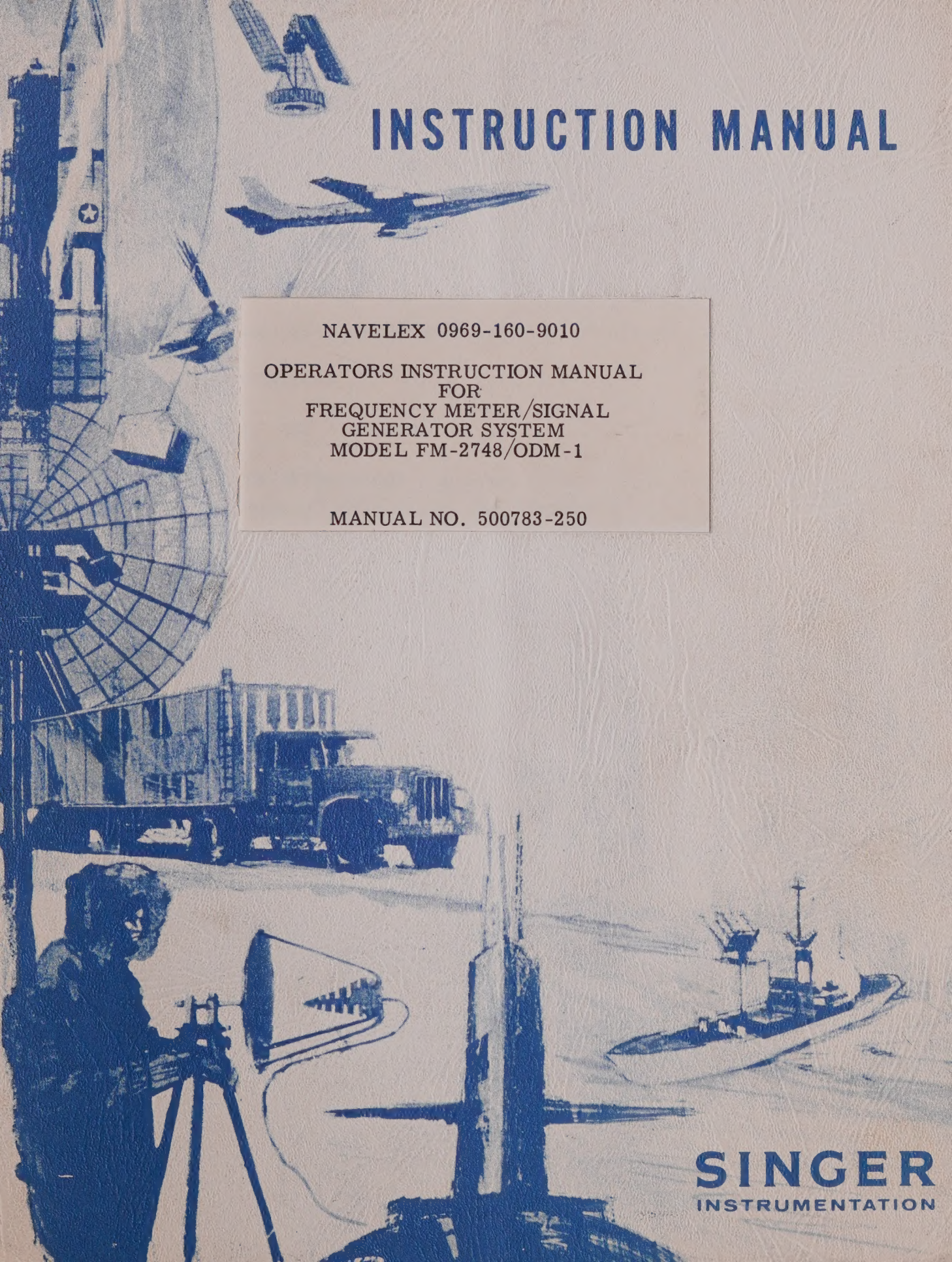
INSTRUCTION MANUAL



NAVELEX 0969-160-9010

OPERATORS INSTRUCTION MANUAL
FOR
FREQUENCY METER/SIGNAL
GENERATOR SYSTEM
MODEL FM-2748/ODM-1

MANUAL NO. 500783-250

SINGER
INSTRUMENTATION

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OPERATORS INSTRUCTION MANUAL FOR FREQUENCY METER/SIGNAL GENERATOR SYSTEM MODEL FM-2748/ODM-1

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SINGER
INSTRUMENTATION

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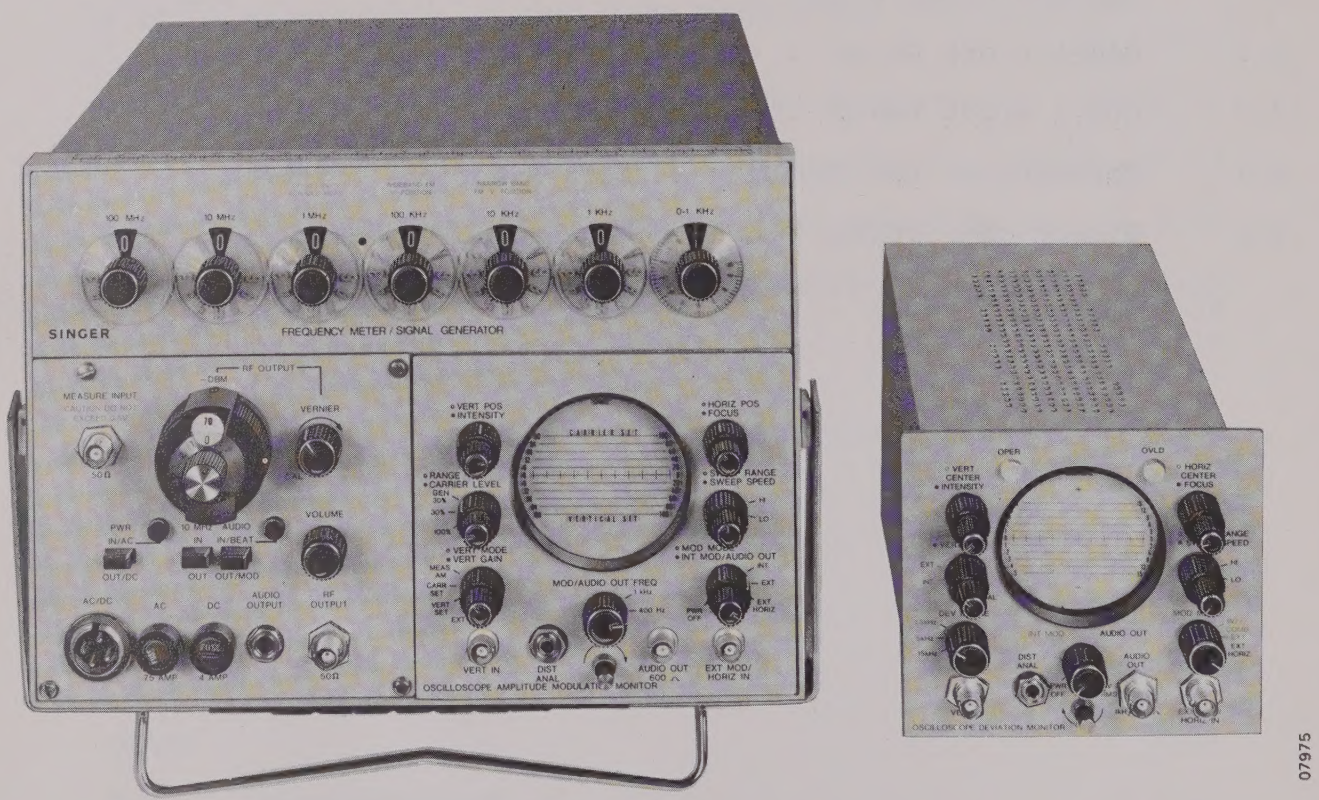

Figure 1-1. FM-2748 (OAM-1 Plugged In) and ODM-1.

SECTION I

INTRODUCTION

1.1 GENERAL

This volume contains operating instructions for Frequency Meter/ Signal Generator (Mainframe), Oscilloscope Amplitude Modulation Monitor OAM-1, and Oscilloscope Deviation Monitor ODM-1. The monitor units are plug-in modules for the Mainframe. The Mainframe accommodates one plug-in module at a time. The Mainframe together with OAM-1 is designated FM-2748, see Figure 1-1.

Operation of the Mainframe is simple and does not involve calibration or locking procedures. Any desired frequency is obtained with full rated accuracy when power is switched on and the frequency controls are set at the specified value.

1.2 SIGNAL GENERATOR FUNCTION

The FM-2748 generates an RF output that is precise in both frequency and level. Signals are generated from 50 kHz to 500 MHz without band switching and are available at a single RF OUTPUT jack. Output level is set at any point from 0.7 μV (-111 dbm) to 223 mV (0 dbm) by switching the RF OUTPUT level control in 1 db steps and the RF OUTPUT VERNIER over a 1 db range. Levels from .07 μV (-131 dbm) to 22.3 mV (-20 dbm) can be obtained by connecting a single RFA-20 attenuator to the RF OUTPUT.

The output is amplitude or frequency modulated using the two modulation plug-in modules. The output can be manually swept over any 1 MHz band within the total frequency range. Precise audio tones are generated and available at a front panel jack.

Stability and resolution of the FM-2748 make it ideal for testing narrow-band receivers or checking the responses of crystal filters, crystal discriminators, or other narrow-band devices.

1.3 FREQUENCY METER/MODULATION MONITOR FUNCTION

Signals being investigated are applied to detection circuitry via the MEASURE INPUT connector by cable or by the plug-in antenna. Locating the exact position of an unknown frequency in the spectrum is greatly simplified by means of an interpolating oscillator. This oscillator provides continuous sweeps over bandwidths of 1 MHz, 100 kHz, or 10 kHz, with one turn of the 0-1 kHz control. The operator initiates a search with sweeps over 1 MHz bands. The procedure is repeated with successive search-bands of 100 kHz and 10 kHz. When the internal frequency is finally balanced against the unknown frequency with all seven frequency controls in the circuit, the value of the unknown frequency is read from the seven dials.

The FM-2748 uses both a light and a built-in speaker to present the beat note. An audio output jack supplies the beat note to a remote speaker when necessary. A 45-ohm speaker is recommended for proper impedance matching. Modulation of the input signal is measured and displayed on the appropriate modulation plug-in. The recovered audio is supplied to the speaker system and is available at the front panel at a level suitable for distortion analysis.

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SECTION II

SPECIFICATIONS

Specifications for the equipment are defined in Table 2-1.

TABLE 2-1. SPECIFICATIONS

GENERATOR FUNCTION	
Frequency range	50 kHz to 500 MHz leveled and calibrated from RF OUTPUT 50 Hz to 5 kHz out to speaker and phone jack 500 MHz to 1 GHz harmonics uncalibrated at RF OUTPUT
Frequency resolution	
Synthesized mode:	1 kHz
Variable decade:	10 Hz = 1/2 division
Frequency accuracy (0 °C to +50°C) (instant on)	
Synthesized mode:	1×10^{-6}
Variable decade:	1×10^{-6} ±50 Hz at 25°C T/C = 2 Hz/°C maximum Error increases by 10 times per decade according to decade in V position. Example: V in 100 KHz decade, error is ±50 KHz.
Frequency stability	
Long term drift:	1×10^{-6}/yr. maximum 1×10^{-7}/mo. maximum
Short term drift:	5×10^{-8}/hr. maximum
Residual FM:	100 Hz maximum as measured in a 40-kHz bandwidth
RF output level	
Range:	-111 dbm (.7 μV) to 0 dbm (223 mV) in 1 db steps and 1 db vernier
Accuracy:	±2 db
RF output impedance	50 ohms at 1.3:1 maximum VSWR
Amplitude modulation (with OAM-1 plug-in)	
Modulation range	
INT:	0-30% at 3% maximum distortion
EXT:	0-30% at 3% maximum distortion 30-50% at 10% maximum distortion

TABLE 2-1. SPECIFICATIONS (CONT)

Modulation frequencies	
INT:	Selectable 400 Hz or 1 kHz ±5%
EXT:	<50 Hz to >20 kHz ±1 db referenced to 1 kHz
Ext. modulation sensitivity:	Requires 0.5 V rms ±20% for 30% modulation at 400 Hz & 1 kHz
Ext. modulation input impedance:	>40 kΩ at 1 kHz
Audio output (front panel output)	
Output impedance:	600 ohm ±20%
Output level:	Adjustable <10 mV to >1 V rms into a 600-ohm load
Distortion:	1% maximum
Frequency:	Selectable 400 Hz or 1 kHz ±5%
Frequency modulation (with ODM-1 plug-in)	
Deviation range:	0-60 kHz peak minimum
Deviation rate	
INT:	1 kHz ±5%
EXT:	<50 Hz to >3 kHz at -3 db referenced to 1 kHz
Ext. modulation sensitivity:	400 mV rms ±10% for 5 kHz peak deviation in narrowband "V" position and 50 kHz in wideband "V" position
Ext. modulation input impedance:	600 ohm ±20%
Audio output (front panel output)	
Output impedance:	600 ohm ±20%
Output level:	Adjustable <10 mV to >1V rms into a 600-ohm load
Distortion:	1% maximum
Frequency:	1 kHz ±5%

TABLE 2-1. SPECIFICATIONS (CONT)

FREQUENCY METER FUNCTION	
Measure input sensitivity:	50 kHz to 1 MHz < 50 mV rms 1 MHz to 500 MHz < 6 mV rms
Measure input impedance:	50 Ω at 1.2:1 maximum VSWR
Measurement accuracy:	A signal can be measured to the frequency accuracy of the internal time base. (See Frequency Accuracy under Generator Function this Table).
Zero beat indication	
Light:	Indicates beat notes below 50 kHz and used to zero beat below audible range
Speaker:	With maximum volume and 1-kHz beat note speaker produces greater than 10 mW of audio at the rated measure sensitivity
Headphone:	700 mV rms minimum at 1-kHz beat note at rated input sensitivity and maximum volume with a source impedance of 56 Ω ±20%
AMPLITUDE MODULATION MONITOR FUNCTION (WITH OAM-1)	
Ranges:	0 to 30% and 0 to 100% (usable to 95%)
Accuracy:	±10% of full scale at 1 kHz
Modulation frequency range:	<50 Hz to > 3 kHz at 3 db referenced to 1 kHz
Sensitivity:	80 mV rms from 50 kHz to 1 MHz 10 mV rms from 1 MHz to 500 MHz referenced to MEASURE INPUT
Distortion analyzer output	
Output level:	300 mV rms ±10% for full scale deflection on CRT at 1 kHz
3 db bandwidth:	<50 Hz to > 3 kHz
Source impedance:	1 kΩ ±20%

TABLE 2-1. SPECIFICATIONS (CONT)

FREQUENCY MODULATION MONITOR FUNCTION (WITH ODM-1)	
Ranges:	±1.5 kHz for full scale on CRT ±5.0 kHz for full scale on CRT ±15 kHz for full scale on CRT
Displayed deviation accuracy	
1 kHz deviation rate:	100 Hz ±5% of F.S.D.
50 Hz to 3 kHz deviation rate:	100 Hz ±7% of F.S.D.
Sensitivity for operate light:	<50 mV rms from 50 kHz to 1 MHz 6 mV rms ±3 db from 1 MHz to 500 MHz referenced to MEASURE INPUT
Sensitivity for overload light:	20db ± 3db above "operate" sensitivity
Modulation bandwidth:	< 50 Hz to > 3 kHz at 3 db referenced to 1 kHz
Distortion analyzer output	
Signal output level:	1.5 V p-p ±10% at 5 kHz peak deviation
DC output level:	4.5V dc ±10%
3 db bandwidth:	< 50 Hz to > 3 kHz (ref to 1 kHz)
Source impedance:	1 kΩ ±20%
OSCILLOSCOPE FUNCTIONS - OAM-1	
Vertical amplifier	
Sensitivity:	300 mV p-p ±10% for full scale deflection
Bandwidth (3 db):	50 Hz to 30 kHz (-3 db referenced to 1 kHz)
Input impedance:	100 kΩ ±20% at 1 kHz

TABLE 2-1. SPECIFICATIONS (CONT)

Attenuation	
Internal:	Fixed steps of 1:1 and 3:10
External:	Continuously variable 1:1 to 1:100
Horizontal amplifier	
Sensitivity:	0.5 V p-p maximum per inch deflection
Input impedance:	>500 kΩ at 1 kHz
Sweep range	
Low:	50 Hz to 500 Hz, variable
High:	500 Hz to 5 kHz, variable
Sweep type:	Recurrent
Sync:	Internal automatic
OSCILLOSCOPE FUNCTIONS - ODM-1	
Vertical amplifier	
Sensitivity:	70 mV p-p ±10% for full scale deflection
Frequency response:	50 Hz to 30 kHz (-3 db referenced to 1 kHz)
Input impedance:	25k ±20%
Attenuation	
Internal:	Fixed steps of 1:1, 3:10 and 1:10
External:	Continuously variable 1:1 to 1:100
Horizontal amplifier	
Sensitivity:	0.5 V p-p maximum per inch deflection
Input impedance:	>500 kΩ at 1 kHz

TABLE 2-1. SPECIFICATIONS (CONT)

Sweep range	
Low:	50 Hz to 500 Hz, variable
High:	500 Hz to 5 kHz, variable
Sweep type:	Recurrent
Sync:	Internal Automatic

MISCELLANEOUS	
Dimensions:	8 3/4" H x 12½" W x 16" D maximum
Weight:	35 lbs
Input voltage:	115V ac ±10% single phase 50-400 Hz or 11.5-15.0 V dc
Input power:	60 watts maximum
Operating temperature:	0° C to +50°C

ACCESSORIES SUPPLIED
BNC to UHF adaptor
AC 3-wire to 2-wire adaptor
Antenna
20 db ±1 db attenuator pad
DC power cord
AC power cord
RF cable
Oscilloscope shield (2 ea)

SECTION III

CONTROLS AND INDICATORS

All control, indicator, and external connector functions are described in Tables 1-2 through 1-4. Each listed control and indicator is keyed to an associated front panel figure that identifies and locates the item. A faceplate figure of each equipment with an associated control and indicator table are presented as follows:

FM-2748	Table 3-1	Figure 3-1
OAM-1	Table 3-2	Figure 3-2
ODM-1	Table 3-3	Figure 3-3

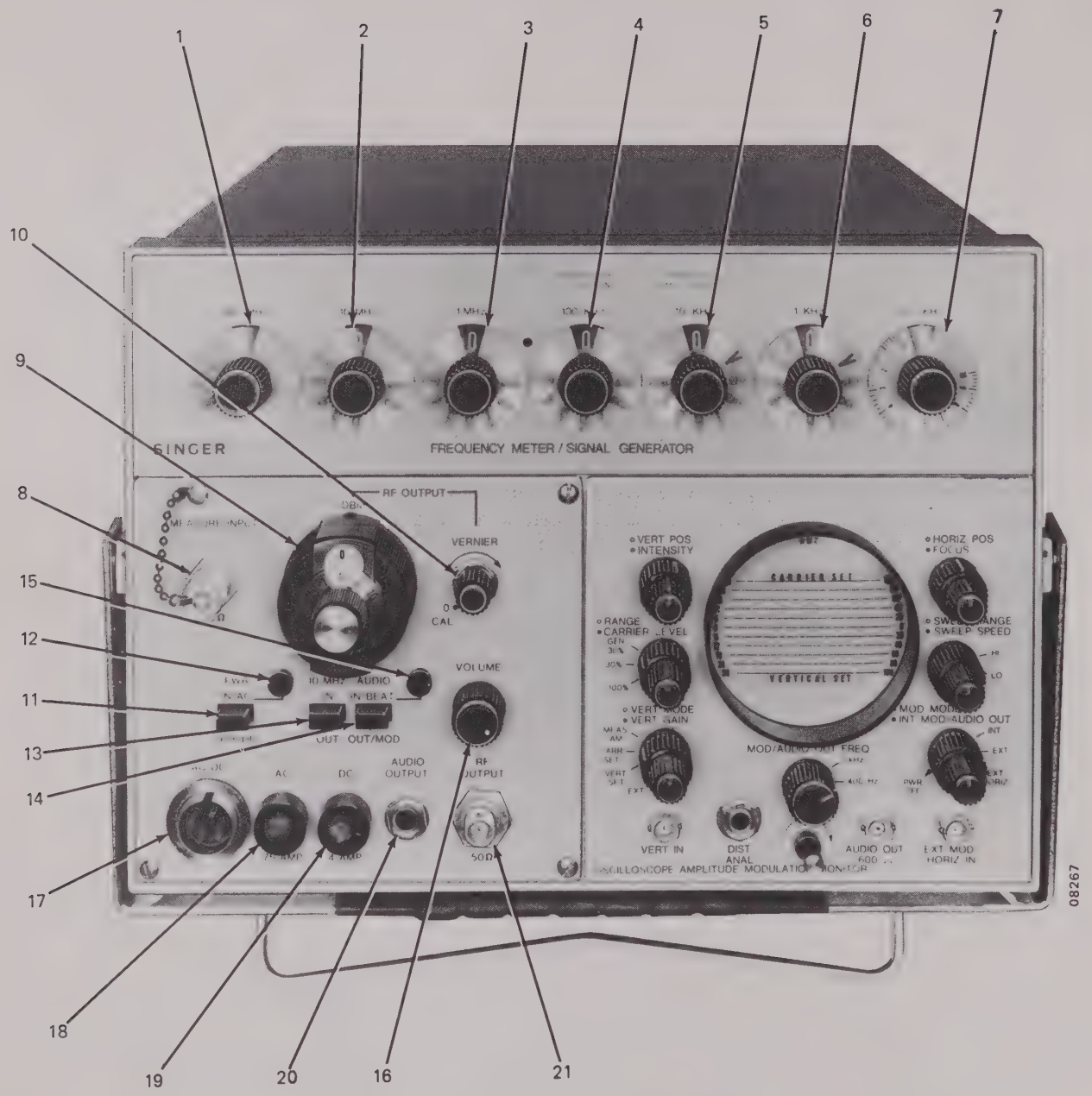


Figure 3-1. FM-2748 Front Panel

TABLE 3-1. MAINFRAME CONTROLS AND INDICATORS

FIG. 3-1 NUMBER	PANEL MARKING	TYPE	FUNCTION
1	100 MHz Dial marking: 0-1-2-3-4	Rotary switch, five-position	Controls frequency in four steps of 100 MHz each.
2	10 MHz Dial marking: 0-1-2-3-4-5-6-7-8-9	Rotary switch, 10-position	Controls frequency in nine steps of 10 MHz each.
3	1 MHz OFFSET 2 MHz FOR MOD MEAS Dial marking: 0-1-2-3-4-5-6-7-8-9	Rotary switch, 10-position	Controls frequency in nine steps of 1 MHz each.
4	100 KHz WIDEBAND FM "V" POSITION Dial marking: 0-1-2-3-4-5-6-7-8-9-V	Rotary switch, 11-position	Controls frequency in nine steps of 100 kHz each. "V" position switches the 0-1 kHz variable resistor (item 7) into circuit with continuous control over the range of 1 MHz.
5	10 KHz NARROWBAND FM "V" POSITION Dial marking: 0-1-2-3-4-5-6-7-8-9-V	Rotary switch, 11-position	Controls frequency in nine steps of 10 kHz. "V" position switches the 0-1 kHz variable resistor into circuit with continuous control over the range of 100 kHz.
6	1 KHz Dial marking: 0-1-2-3-4-5-6-7-8-9-V	Rotary switch, 11-position	Controls frequency in nine steps of 1 kHz. "V" position switches the 0-1 kHz variable resistor into circuit with continuous control over the range of 10 kHz.

TABLE 3-1. MAINFRAME CONTROLS AND INDICATORS (CONT)

FIG. 3-1 NUMBER	PANEL MARKING	TYPE	FUNCTION
7	0-1 KHz Dial marking: 0-1-2-3-4-5-6- 7-8-9-10-OUT	Variable resistor	Controls frequency continuously over four ranges: 0-1 kHz 0-10 kHz (with 1 kHz control in V position) 0-100 kHz (with 10 kHz control in V position) 0-1 MHz (with 100 kHz control in V position) Frequency range is 0-1 kHz when 1 kHz, 10 kHz, or 100 kHz controls are not in "V" position.
8	MEASURE INPUT	Connector, BNC Female	Input connector
9	RF OUTPUT	Attenuator, scaled in -dbm (0 to -110 in 1db steps)	Controls RF output and reads directly in -dbm into 50 ohms.
10	VERNIER 0 CAL	Variable resistor	Controls RF output level over greater than 1 db range.
11	PWR IN/AC OUT/DC	Switch, pushbutton	Controls power supply. Push to IN position for ac operation. Push to OUT position for dc operation.
12	PWR	Light	Indicates output from internal power supply.
13	10 MHz IN OUT	Switch, pushbutton	Applies 10 MHz signal directly from TCXO crystal to detector. Produces audio frequency at phone jack with same accuracy as TCXO.

TABLE 3-1. MAINFRAME CONTROLS AND INDICATORS (CONT)

FIG. 3-1 NUMBER	PANEL MARKING	TYPE	FUNCTION
14	AUDIO IN/BEAT OUT/MOD	Switch, pushbutton	Switches loudspeaker into beat detector circuit. Should be in the IN position at all times except when a plug-in module is used.
15	BEAT	Light	Provides visual indication of beat note when frequency is less than 50 kHz.
16	VOLUME	Variable resistor	Controls speaker volume and output at AUDIO OUTPUT connector.
17	AC/DC	Connector, socket	Provides connection to ac or dc source.
18	AC	Fuse, .75-A	Protects 115/230 V ac input circuits.
19	DC	Fuse, 4-A	Protects dc input circuit.
20	AUDIO OUTPUT	Connector, phone jack	Supplies audio output signal.
21	RF OUTPUT	Connector	Supplies calibrated output controlled by RF OUTPUT attenuator.
NA	CHASSIS CONNECTOR (J-11 R.H. MODULE)	NA	
	Pin 1		10 MHz signal from TCXO Buffer at a level of 0.5 V p-p into a 50 Ω load and with a source impedance of 50 Ω . Is dc coupled and requires a capacitively coupled load.

TABLE 3-1. MAINFRAME CONTROLS AND INDICATORS (CONT)

FIG. 3-1 NUMBER	PANEL MARKING	TYPE	FUNCTION
	Pin 2		Chassis ground
	Pin 3		Shield ground for pin 11.
	Pin 4		Shield ground for pin 12.
	Pin 6		Shield ground for pin 14.
	Pin 8		Shield ground for pin 16.
	Pin 9		9 V dc ±10% with 1 mV rms maximum ripple at 1 A maximum current
	Pin 10		Shield ground for pin 1.
	Pin 11		Amplitude modulator input. Bandwidth of <50 Hz to >20 kHz. Input impedance is 500 ohms ±20%. Sensitivity is 75 mV rms ±10% for 30% amplitude modulation. Is dc coupled and must be driven from a capacitively coupled source.
	Pin 12		Frequency modulator input. Bandwidth is <50 Hz to >3 kHz. Input impedance is 8 kΩ to 15 kΩ. Sensitivity is 100 mV rms ±5% per 1 kHz modulation with variable in 10 kHz decade and 100 mV rms ±5% per 10 kHz modulation with variable in 100 kHz decade.

TABLE 3-1. MAINFRAME CONTROLS AND INDICATORS (CONT)

FIG. 3-1 NUMBER	PANEL MARKING	TYPE	FUNCTION
	Pin 14		Audio input to Audio Amplifier. Input impedance is 250 ohms ±20% at 1 kHz. Bandwidth <300 Hz to >5 kHz. Requires 75 mV p-p ±20% at 1 kHz to produce 5 V p-p across speaker at maximum volume.
	Pin 16		2 MHz IF with nominal 30Ω source impedance. Level is set at 2.5 mV rms into load impedance of 200 ohms. 3 db bandwidth is 60 kHz minimum and 90 kHz maximum.

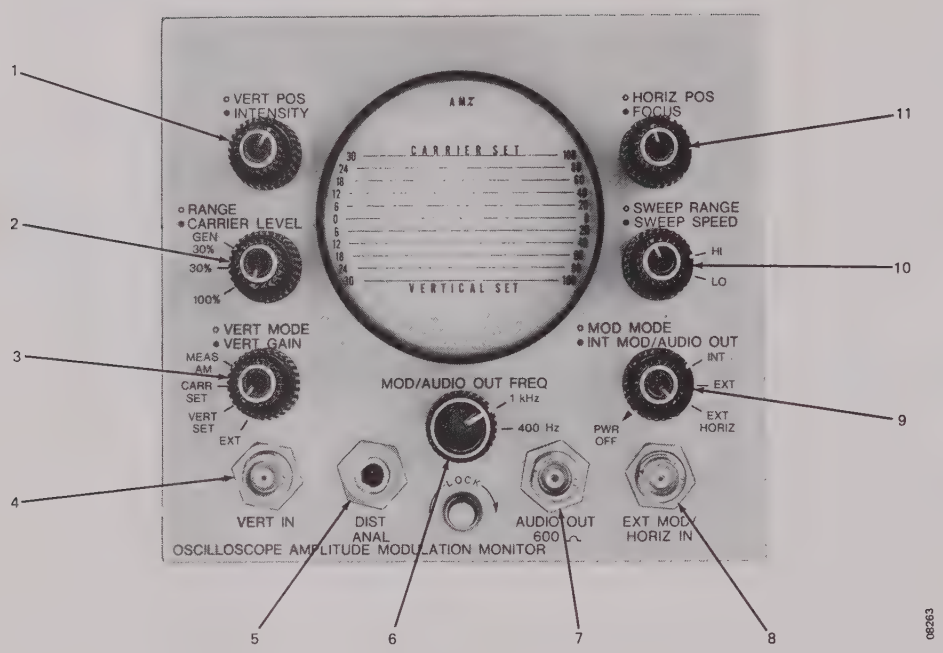


Figure 3-2. OAM-1 Front Panel

TABLE 3-2. OAM-1 CONTROLS AND INDICATORS

FIG. 3-2 NUMBER	PANEL MARKING	TYPE	FUNCTION
1	VERT POS (Outer knob)	Variable resistor	Controls vertical position of CRT trace.
	INTENSITY (Inner knob)	Variable resistor	Controls brightness of CRT trace. Used with FOCUS control to obtain clear trace.
2	RANGE (Outer knob)	Switch, three-position	
	GEN 30%		Enables internal or external modulation of Mainframe carrier up to 30%.
	30%		Provides oscilloscope sensitivity for measuring of modulated carriers up to 30%.
	100%		Provides oscilloscope sensitivity for measuring of modulated carriers up to 100%.
	CARRIER LEVEL (Inner knob)	Variable resistor	Calibrates modulation sensitivity.
3	VERT MODE (Outer knob)	Switch, four-position	
	MEAS AM		Modulated signal to be measured is applied to oscilloscope vertical amplifier input.
	CARR SET		Carrier, minus modulation, is applied to oscilloscope vertical amplifier input.
	VERT SET		Zero signal (ground) is applied to oscilloscope vertical amplifier input.
	EXT		Oscilloscope vertical amplifier input is switched to VERT IN connector.

TABLE 3-2. OAM-1 CONTROLS AND INDICATORS (CONT)

FIG. 3-2 NUMBER	PANEL MARKING	TYPE	FUNCTION
3 Cont	VERT GAIN (Inner knob)	Variable resistor	Varies level of external signal applied to VERT IN connector. Effective when VERT MODE switch is at EXT position only.
4	VERT IN	Connector, BNC	Provides connection to oscilloscope vertical amplifier input when VERT MODE switch is at EXT position. External signal level is controlled with VERT GAIN control.
5	DIST ANAL	Jack	Provides demodulated audio for output to a Distortion Analyzer and regulated +9V dc at 50 mA (max) for FM accessory items.
6	MOD/AUDIO OUT FREQ 1 kHz 400 Hz	Switch, two-position	Controls frequency of the internal modulation oscillator.
7	AUDIO OUT 600 Ω	Connector, BNC	Connects 400 Hz or 1 kHz signal. Level is controlled from 0 to 1 V rms by INT MOD/AUDIO OUT control.
8	EXT MOD/ HORIZ IN	Connector, BNC	Connects an external modulation tone to modulation circuit when MOD MODE switch is at EXT position. Connects an external horizontal drive when MOD MODE switch is at EXT HORIZ position (no internal sync from oscilloscope vertical amplifier).

TABLE 3-2. OAM-1 CONTROLS AND INDICATORS (CONT)

FIG. 3-2 NUMBER	PANEL MARKING	TYPE	FUNCTION
9	MOD MODE (Outer knob)	Switch, three-position	
	INT		Connects internal sweep generator (synchronized by oscilloscope vertical amplifier signal) to oscilloscope horizontal amplifier input. Also connects internal modulation oscillator (400 Hz or 1 kHz) output (level controlled by INT MOD/AUDIO OUT control) to internal AM amplifier to internally modulate Mainframe carrier up to 30%.
	EXT		Connects internal sweep generator (synchronized by oscilloscope vertical amplifier signal) to oscilloscope horizontal amplifier input. Also connects EXT MOD/HORIZ IN connector to input of internal AM amplifier to externally modulate Mainframe carrier up to 30%.
	EXT HORIZ		Connects oscilloscope horizontal amplifier to EXT MOD/HORIZ IN connector to enable external sweep of oscilloscope. Also disconnects input to internal AM amplifier.
	INT MOD/ AUDIO OUT (Inner knob)	Variable resistor power switch	Controls internal modulation level when MOD MODE switch is at INT position, controls level of 400-Hz and 1-kHz tone (available at AUDIO OUT connector) from 0 to 1 V rms, and controls power to OAM-1 module.
	PWR OFF		
10	SWEEP RANGE (Outer knob)	Switch, two-position	Provides coarse control of sweep speed. Is switched out of circuit when an external horizontal input signal is used and MOD MODE is at EXT HORIZ.
	HI		
	LO		

TABLE 3-2. OAM-1 CONTROLS AND INDICATORS (CONT)

FIG. 3-2 NUMBER	PANEL MARKING	TYPE	FUNCTION
10 Cont	SWEEP SPEED (Inner knob)	Variable resistor	Provides fine control of sweep speed.
11	HORIZ POS (Outer knob)	Variable resistor	Controls horizontal position of CRT trace.
	FOCUS	Variable resistor	Controls dispersion of CRT beam. Used with INTENSITY control to obtain sharp trace.
	Rear panel Connector P1	16 pin plug	
		Pin #2	Chassis Ground
		Pin #3	Cable Shield for Pin #11
		Pin #6	Cable Shield for Pin #14
		Pin #8	Cable Shield for Pin #16
		Pin #9	+9V dc ±10% at 900 ma max. (regulated)
		Pin #11	Audio modulation signal to AM modulator in mainframe. 80 mV rms minimum with R2 full CW and S-6 in Int. position. With S-6 in Ext. position level is proportional to level applied to J4, (15 mV ±5% for 100 mV rms at J4). Output impedance 10 ohms ±20%.
		Pin #14	Recovered audio out to audio amplifier mainframe. Output impedance 120 ohm ±20% at 1 kHz with level proportional to % of modulation. 100 mV rms ±10% for full scale modulation, i.e., 30% and 100%.

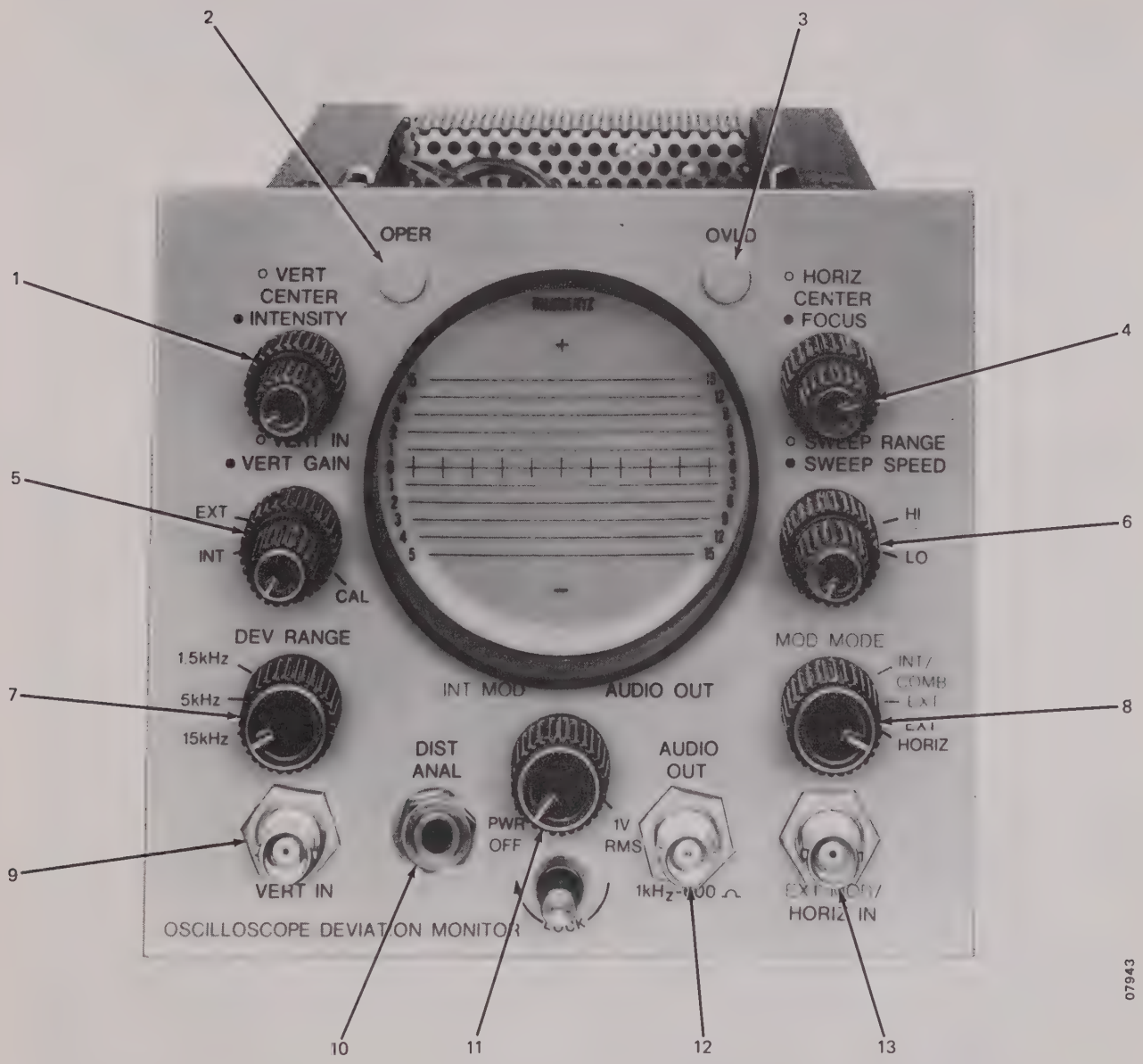


Figure 3-3. ODM-1 Front Panel

TABLE 3-3. ODM-1 CONTROLS AND INDICATORS

FIG. 3-3 NUMBER	PANEL MARKING	TYPE	FUNCTION
1	VERT CENTER (Outer knob)	Variable resistor	Controls vertical position of CRT trace.
	INTENSITY (Inner knob)	Variable resistor	Controls brightness of CRT trace. Used with FOCUS control to obtain clear trace.
2	OPER	Indicator light	Indicator is off when too little or too much IF signal is applied to the input. Indicator is on when IF signal level is in acceptable range. NOTE: OPER indicator is linked with OVLD indicator so that both are never on at the same time.
3	OVLD	Indicator light	Indicator is off at all times except when IF signal is excessive. OVLD goes off and OPER comes on when IF signal is decreased to proper level.
4	HORIZ CENTER (Outer knob)	Variable resistor	Controls horizontal position of CRT trace.
	FOCUS	Variable resistor	Controls dispersion of beam on CRT. Used with INTENSITY control to obtain sharp trace.
5	VERT IN (Outer knob)	Switch, two-position	
	INT		Switches oscilloscope vertical input to output of internal demodulator.
	EXT		Switches oscilloscope vertical input to VERT IN connector.

TABLE 3-3. ODM-1 CONTROLS AND INDICATORS (CONT)

FIG. 3-3 NUMBER	PANEL MARKING	TYPE	FUNCTION
5 Cont	VERT GAIN (Inner knob) CAL	Variable resistor	Varies vertical gain. When VERT IN switch is at EXT position, CAL position indicates the maximum sensitivity end of its range.
6	SWEEP RANGE (Outer knob)	Switch, two-position	Provides coarse control of sweep speed. Is switched out of circuit when an external horizontal input signal is used and MOD MODE switch is at EXT HORIZ.
	HI		
	LO		
	SWEEP SPEED (Inner knob)	Variable resistor	Provides fine control of sweep speed.
7	DEV RANGE	Switch, three-position	Selects calibrated vertical input ranges.
	1.5 kHz		
	5 kHz		
	15 kHz		
8	MOD MODE	Switch, three-position	
	INT/COMB		Switches an internal 1-kHz modulation tone (controlled by INT MOD/AUDIO OUT control) and an external signal at the EXT MOD/HORIZ IN connector into the modulation circuit. The external modulation tone supplied to EXT MOD/HORIZ IN connector is combined with the internal 1-kHz tone.
	EXT		Removes the internal 1-kHz signal from the modulation circuit. Only the signal from EXT MOD/HORIZ IN connector is in the circuit.
	EXT HORIZ		Switches EXT MOD/HORIZ IN connector into the horizontal drive circuit.

TABLE 3-3. ODM-1 CONTROLS AND INDICATORS (CONT)

FIG. 3-3 NUMBER	PANEL MARKING	TYPE	FUNCTION
9	VERT IN	Connector, BNC	Provides connection to vertical amplifier when VERT IN switch is at EXT.
10	DIST ANAL	Jack	Connects demodulated audio output to a Distortion Analyzer.
11	INT MOD/ AUDIO OUT	Variable resistor, switched	Controls internal modulation level when MOD MODE switch is at INT/COMB. Also controls level of 1 kHz tone (available at AUDIO OUT connector) from 0 to 1 V rms and controls power to ODM-1 module.
12	AUDIO OUT 600Ω	Connector, BNC	Connects 1 kHz output signal. Level is controlled from 0 to 1 V rms by INT MOD/AUDIO OUT control.
13	EXT MOD/ HORIZ IN	Connector, BNC	Connects an external modulation tone to modulation circuit when MOD MODE switch is at INT/ COMB or EXT.
			Provides an external horizontal drive when MOD MODE switch is at EXT HORIZ.
	Rear panel connector P1	16 pin plug	
	Pin 2		Chassis ground
	Pin 4		Cable shield for pin 12
	Pin 5		Same as DIST ANAL output
	Pin 6		Cable shield for pin 14
	Pin 8		Cable shield for pin 16
	Pin 9		+9 V dc ±10% at 900 mA maximum (regulated)

TABLE 3-3. ODM-1 CONTROLS AND INDICATORS (CONT)

FIG. 3-3 NUMBER	PANEL MARKING	TYPE	FUNCTION
13 Cont	Pin 12		Audio signal from internal 1 kHz oscillator or 50 Hz to 3 kHz external modulation source. Source impedance is less than 100 ohms. Level set at 500 mV rms ±5% with 400 mV rms into EXT MOD/HORIZ IN jack or greater than 500 mV rms from internal modulation source with AUDIO OUT level at maximum. Levels are set into 5.6 K load.
	Pin 13		Cable shield for pin 5.
	Pin 14		Recovered audio out signal to audio amplifier in Mainframe. Should be greater than 40 mV rms into a 100-ohm load for full scale deflection. 3-db bandwidth should be greater than 50 Hz to 3 kHz.
	Pin 16		2-MHz IF input from Mainframe at level of 2.5 mV rms ±3 db at rated sensitivity of Mainframe. Input impedance is 200 ohms nominal.

SECTION IV

OPERATING PROCEDURES

4.1 POWER SUPPLY CONNECTIONS (MAINFRAME)

To use a dc source, 11.5 V to 15 V:

a. Connect power to the AC/DC connector.

b. Use special dc cable assembly provided to connect to a car or truck battery.

NOTE: Make certain that the external source provides a negative ground to prevent reverse polarity from blowing the dc fuse (FM-2748 case is connected to the dc negative line).

To use a 115 V ac source, plug power cord into 115 V ac 3-pin type source.

NOTE: The Mainframe is supplied pre-set to 115 V ac for use in North America unless otherwise indicated by a decal over the AC/DC socket. Power cord supplied is 3-pin for use with 115 V grounded mains supply.

To convert to 230 V ac operation:

a. Remove cover by removing four screws on back of case.

b. Set voltage switch marked 115 at 230 V setting (Switch is located behind left-hand panel and is exposed when cover is removed).

c. Replace cover.

d. Plug into source.

4.2 START PROCEDURE (FM-2748)

To switch on power:

a. For dc, set PWR switch at OUT/DC.

b. For ac, set PWR switch at IN/AC.

NOTE: To obtain accuracy of 1×10^{-7}, compare accuracy against higher accuracy standard and adjust TCXO after 1 hour temperature soak.

4.3 SIGNAL GENERATOR FUNCTION -- CW SIGNAL ONLY (No Plug-in Required)

4.3.1 SET-UP PROCEDURE.

a. Push 10 MHz switch to OUT.

b. Make output connection to RF OUTPUT connector as shown in Figure 4-1.

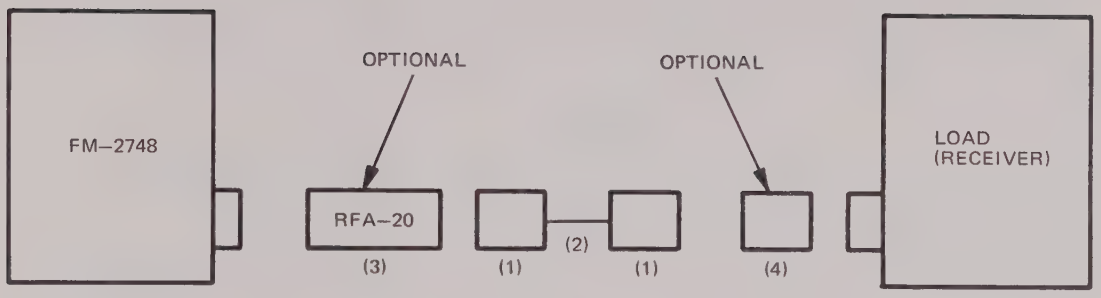
c. For output levels between -110 dbm and 0 dbm, connect load directly to RF OUTPUT connector and set output level with RF OUTPUT attenuator. For output levels between -130 dbm and -20 dbm, connect load to RF OUTPUT connector through RFA-20 pad and increase RF OUTPUT attenuator reading by -20 dbm.

NOTE: The RF OUTPUT VERNIER control allows infinite resolution on the output level with the RF OUTPUT attenuator indicating the output level in -dbm when the RF OUTPUT VERNIER control is at the 0 CAL position.

d. Dial desired frequency on the frequency controls.

e. Adjust signal level with RF OUTPUT controls.

> CAUTION
>
> Do not key the transmitter while directly connected to FM-2748 RF output. Keying will burn out the RF fuse assembly.



ITEM	DESCRIPTION
1	BNC CONNECTOR MALE
2	RG–58U COAX CABLE
3	RFA–20 ATTENUATOR
4	BNC TO UHF ADAPTER, UG–273/U

Figure 4-1. Connections for Signal Generator Function

4.3.2 MANUAL FREQUENCY SWEEP. Setup base frequency and output level as described in 4.3.1.

4.3.2.1 To Manually Sweep 1 MHz.

a. Set 100 KHz frequency control at V.

b. Rotate 0-1 KHz frequency control through its full range. Output frequency increases by 1 MHz.

4.3.2.2 To Manually Sweep 100 kHz.

a. Set 10 KHz frequency control at V and 100 kHz control not to V.

b. Rotate 0-1 KHz frequency control through its full range. Output frequency increases by 100 kHz.

4.3.2.3 To Manually Sweep 10 kHz.

a. Set 1 KHz frequency control at V and 100 kHz control not to V.

b. Rotate 0-1 KHz frequency control through its full range. Output frequency increases by 10 kHz.

4.4 FREQUENCY METER FUNCTION (No Plug-in Required)

4.4.1 ANTENNA SET-UP. Connect antenna provided to MEASURE INPUT connector.

CAUTION

Do not overload the instrument with excessive RF signal. Decrease input level at MEASURE INPUT, if required by decreasing the length of the antenna or by adding 20 dB pads between the antenna and the RF ONPUT connector as required.

4.4.2 DIRECT CONNECTION SET-UP.

a. Connect RFA-60, load, and unit under test as shown in Figure 4-2.

b. If FM-2748 is overloaded, connect RFA-20 in line between FM-2748 and RFA-60.

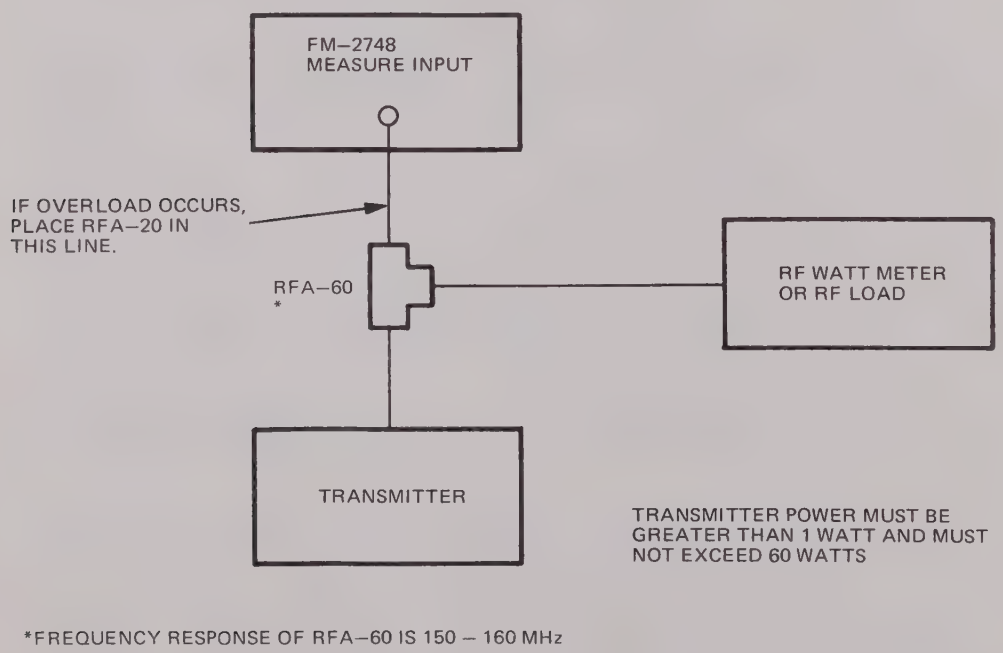

FM–2748
MEASURE INPUT
IF OVERLOAD OCCURS, PLACE RFA–20 IN THIS LINE.
RFA–60
*
RF WATT METER OR RF LOAD
TRANSMITTER
TRANSMITTER POWER MUST BE GREATER THAN 1 WATT AND MUST NOT EXCEED 60 WATTS
*FREQUENCY RESPONSE OF RFA–60 IS 150 – 160 MHz

Figure 4-2. Direct Connection, Frequency Measuring Function

4.4.3 KNOWN TRANSMITTER FREQUENCY. When the transmitter frequency is within a few hundred hertz of a known channel frequency:

> CAUTION
>
> Transmitter power should not exceed 60 watts.

a. Push 10 MHz switch to OUT.

b. Push AUDIO switch to IN/BEAT.

NOTE: For remote presentation of beat note, connect a speaker to the AUDIO OUTPUT jack. Use VOLUME control to adjust beat note level. Internal speaker is disconnected when an external unit is connected into the AUDIO OUTPUT jack.

c. Set frequency controls at channel frequency.

d. Key transmitter.

e. Observe beat note and reduce to zero by adjusting 0-1 KHz frequency control. Ensure that no frequency control is at V position.

f. Read actual transmitter frequency from frequency control dials.

4.4.4 UNKNOWN TRANSMITTER FREQUENCY. When only the approximate transmitter frequency is known (within a range of 1 megahertz):

a. Set megahertz frequency controls (100 MHz, 10 MHz, and 1 MHz) at a frequency slightly below presumed value.

b. Set 100 KHz frequency control at V.

c. Search for zero beat by turning 0-1 KHz frequency control.

d. Observe zero beat and read least significant decimal of 0-1 KHz frequency control (reading is in 100 kHz per decimal).

e. Set 100 KHz frequency control at value obtained in step d.

f. Set 10 KHz frequency control at V.

g. Repeat steps c and d (reading is in 10 kHz per decimal). Set 10 KHz frequency control at value obtained.

h. Set 1 KHz frequency control at V.

j. Repeat steps c and d (the reading is in 1 kHz per decimal).

k. Set 1 KHz frequency control at value obtained in step j.

l. Turn 0-1 KHz frequency control until zero beat is obtained.

m. Read exact frequency from all seven frequency control dials.

4.5 PRELIMINARY OSCILLOSCOPE SET-UP (MAINFRAME/OAM-1)

a. Apply power to Mainframe.

b. Apply power to OAM-1 module by turning INT MOD/AUDIO OUT control CW. Push AUDIO switch on Mainframe to OUT/MOD. Allow approximately 1 minute for warm-up.

c. Set OAM-1 controls as follows:

MOD MODE	INT
INTENSITY	As required
FOCUS	For sharpest trace
VERT POS	For desired position
HORIZ POS	For desired position
VERT GAIN	Fully CCW

d. Adjust VERT POS, INTENSITY, HORIZ POS, and FOCUS controls for sharpest trace and desired position on CRT.

4.6 AMPLITUDE MODULATED SIGNAL GENERATOR (MAINFRAME/OAM-1)

The Mainframe with the OAM-1 module are used as a signal generator that can be internally amplitude modulated by either 400 or 1000 Hz or externally modulated with frequencies from $\lesssim$ 50 Hz to $\gtrsim$20 kHz.

4.6.1 INTERNAL MODULATION.

a. Set Mainframe frequency controls at 12.000 MHz.

b. Push 10 MHz switch on Mainframe to IN.

c. Set OAM-1 VERT MODE switch at VERT SET.

d. Adjust VERT POS control to position trace at VERTICAL SET line of graticule.

e. Set VERT MODE switch at CARR SET.

f. Adjust CARRIER LEVEL control to position trace at CARRIER SET line of graticule.

g. Set RANGE switch at GEN 30%.

h. Set VERT MODE switch at MEAS AM.

j. Set MOD/AUDIO OUT FREQ control at desired modulation frequency (400 to 1000 Hz) and adjust INT MOD/AUDIO OUT control for desired percentage of modulation (30% maximum).

k. Place 10 MHz switch on Mainframe at OUT.

NOTE: The FM-2748 is modulated at the percentage set in step j ±10% for any frequency selected with the frequency controls.

4.6.2 EXTERNAL MODULATION.

a. Connect external modulating source to OAM-1 EXT MOD/HORIZ IN connector (500 mV rms ±20% for 30% modulation, <50 Hz to >20 kHz).

b. Set Mainframe frequency controls at 12.000 MHz.

c. Push 10 MHz switch on Mainframe to IN.

d. Set OAM-1 VERT MODE switch at VERT SET.

e. Adjust VERT POS control to position trace at VERTICAL SET line of graticule.

f. Set VERT MODE switch at CARR SET.

g. Adjust CARRIER LEVEL control to position trace at CARRIER SET line of graticule.

h. Set RANGE switch at GEN 30%.

j. Set VERT MODE switch at MEAS AM.

k. Set MOD MODE switch at EXT.

l. Set level of external modulating source for desired percentage of modulation (30% maximum at 3% distortion). Increasing modulating source level by 125 mV rms produces approximately 50% modulation at 10% maximum distortion.

m. Push 10 MHz switch on Mainframe to OUT.

NOTE: The FM-2748 is externally modulated at the percentage set in step 1 ±10% for any frequency set by the frequency controls.

4.7 PRELIMINARY OSCILLOSCOPE SET-UP (MAINFRAME/ODM-1)

a. Apply power to Mainframe.

b. Apply power to ODM-1 module by turning INT MOD/AUDIO OUT control CW. Allow approximately 1 minute for warm-up. Set AUDIO switch on Mainframe at OUT/MOD.

c. Set ODM-1 controls as follows:

MOD MODE	INT
INTENSITY	Fully CW
VERT GAIN	CAL
VERT POS	Mid position
HORIZ POS	Mid position
FOCUS	For sharpest trace

4.8 INTERNALLY FREQUENCY MODULATED SIGNAL GENERATOR (MAINFRAME/ODM-1)

4.8.1 NARROWBAND (0-5 kHz) PEAK DEVIATION. Example: Modulate 273.939 MHz to 5 kHz peak deviation.

a. Set controls as follows:

Frequency controls	008.0V00
10 MHz	IN
DEV RANGE	5 kHz
VERT IN	INT
VERT GAIN	CAL
MOD MODE	INT/COMB
INT MOD/AUDIO OUT	CCW (not off)
0-1 KHz	0 (not out)

b. Turn INT MOD/AUDIO OUT control until wave height reaches 5 kHz.

c. Push 10 MHz switch to OUT.

d. Set Mainframe frequency controls at desired carrier frequency (273.9390 MHz).

e. Set 0-1 KHz frequency at same value as 10 KHz and 1 KHz frequency controls (3.9).

f. Set 10 kHz frequency control at V.

g. Mainframe FM-2748/ODM-1 is now generating 5 kHz peak deviation at 273.939 MHz.

4.8.2 WIDEBAND (5-15 kHz) PEAK DEVIATION. Example: Modulate 273.9398 MHz to 15 kHz.

a. Set controls as follows:

Frequency controls	008.V000
10 MHz	IN
DEV RANGE	15 kHz
VERT IN	INT
VERT GAIN	CAL
MOD MODE	INT/COMB
INT MOD/AUDIO OUT	Fully CCW
0-1 KHz	0 (not OUT)

b. Turn INT MOD/AUDIO OUT control until wave height reaches 15 kHz.

c. Push 10 MHz switch to OUT.

d. Reset Mainframe frequency controls at carrier frequency (273.9398 MHz).

e. Set 0-1 KHz frequency control at value of 100 KHz and 10 KHz frequency controls (9.39 or 9.4).

f. Set 100 KHz frequency control at V.

g. Mainframe/ODM-1 is now generating 15 kHz peak deviation at 273.9398 MHz.

4.8.3 WIDEBAND (15-60 kHz) PEAK DEVIATION

NOTE: The Mainframe/ODM-1 provides peak deviation measurements to 15 kHz. However, peak deviations as high as 60 kHz can be generated by the following procedure.

Example: Modulate 36.2471 MHz to 50 kHz peak deviation.

a. Set controls as follows:

Frequency controls	008.0V00
10 MHz	IN
AUDIO	OUT/MOD
INT MOD/AUDIO OUT	CCW (not off)
VERT IN	INT
VERT GAIN	CAL
DEV RANGE	5 kHz
MOD MODE	INT/COMB
0-1 kHz	0 (not OUT)

b. Turn INT MOD/AUDIO OUT control until wave height reaches one tenth of desired peak deviation (5 kHz).

c. Push 10 MHz switch to OUT.

d. Reset frequency controls to carrier frequency (36.2471 MHz).

e. Set 0-1 KHz frequency control at same value as 100 kHz and 10 KHz controls (2.47 or 2.5).

f. Set 100 KHz frequency control at V.

g. Mainframe/ODM-1 is now generating 50 KHz peak deviation at 36.247 MHz.

NOTE: In the example, the peak deviation of 5 kHz is set up with the 10 KHz frequency control in the V position. This is multiplied by 10 when the 100 KHz frequency control is set at V in step f. The peak deviation thus becomes 50.0 kHz.

4.9 COMBINED INTERNAL/EXTERNAL (TWO-TONE) FM SIGNAL GENERATOR (MAINFRAME/ODM-1)

a. Set Audio Oscillator at desired frequency and set at zero output.

b. Connect Audio Oscillator to EXT MOD/HORIZ IN jack on ODM-1.

c. Set controls as follows:

0-1 KHz	0 (not OUT)
10 MHz	IN
AUDIO	OUT/MOD
Frequency controls	008.V00 MHz (wideband deviation)
	008.0V0 MHz (narrowband deviation)
VERT GAIN	CAL
VERT IN	INT
MOD MODE	INT/COMB
DEV RANGE	As required
INT MOD/AUDIO OUT	CCW (not off)

d. Adjust VERT CENTER to align trace on CRT.

e. Turn INT MOD/AUDIO OUT control CW until wave height reaches desired peak deviation for the internal 1 kHz tone.

f. Set MOD MODE at EXT. Increase Audio Oscillator output until wave height on CRT reaches total peak deviation required for the external tone.

g. Set MOD MODE at INT/COMB and 10 MHz at OUT.

h. Set Mainframe frequency controls at desired carrier frequency.

Example: 97.3527 MHz.

j. Set 10 KHz or 100 KHz frequency control at V position, according to whether narrowband or wideband modulation is required.

k. Set 0-1 KHz frequency control at the appropriate setting: 3.527 for wideband or 5.27 for narrowband.

l. Mainframe/ODM-1 is now generating two-tone frequency modulation at the desired carrier frequency.

4.10 EXTERNALLY FREQUENCY MODULATED SIGNAL GENERATOR (MAINFRAME/ODM-1)

Repeat procedure of paragraph 4.8.4 with MOD MODE switch at EXT and omitting internal modulation (step f).

NOTE: Internal 1 kHz modulation oscillator is out of the circuit when MOD MODE is at EXT.

4.11 MEASUREMENT OF AMPLITUDE MODULATION (MAINFRAME/OAM-1)

a. Set Mainframe frequency controls at frequency of transmitter. Example: Transmitter frequency is 120.0261 MHz.

b. Offset Mainframe frequency ±2 MHz, for above example: 118.0261 MHz or 122.0261 MHz.

NOTE: Always add 2 MHz whenever possible.

c. Couple transmitter output to Mainframe MEASURE INPUT connector via the antenna provided, or use RF cable input with an RFA-60 attenuator in the line (see paragraph 4.4.1 or 4.4.2).

d. Set VERT MODE switch at VERT SET.

e. Adjust VERT POS control to position the trace on VERTICAL SET line of graticule.

f. Set VERT MODE switch at CARR SET.

g. Adjust transmitter coupling to Mainframe and/or CARRIER LEVEL control to position trace at CARRIER SET line of graticule.

h. Set RANGE switch at desired range (30% or 100% full scale).

j. Set VERT MODE switch at MEAS AM. Adjust transmitter modulation to desired percentage as indicated by scope calibration scale.

k. To check distortion connect Distortion Analyzer to DIST ANAL output and make distortion measurement.

4.12 AUDIO TEST TONE GENERATION (MAINFRAME/OAM-1)

Either 400 Hz or 1 kHz tone modulation developed by the Mainframe/OAM-1 is available at all times at the AUDIO OUT 600Ω connector for testing of transmitters or repeaters.

a. Connect transmitter microphone input to AUDIO OUTPUT 600Ω connector.

b. Set MOD/AUDIO OUT FREQ switch at desired tone modulation frequency, 400 Hz or 1 kHz.

c. Set INT MOD/AUDIO OUT control at level desired (a maximum of 1 V rms into 600 ohms is available).

d. Mainframe/OAM-1 is now supplying a 400-Hz or 1-kHz tone with 600 ohms output impedance.

4.13 MEASUREMENT OF PEAK DEVIATION (MAINFRAME/ODM-1)

a. Set frequency controls at frequency of transmitter. Example: transmitter frequency is 276.0359 MHz.

b. Offset Mainframe frequency by ±2 MHz, for above example: 274.0359 MHz or 278.0359 MHz.

NOTE: Always add 2 MHz whenever possible. The polarity of the displayed deviation is only correct when the Mainframe frequency is above the incoming signal frequency.

c. Couple transmitter FM output to MEASURE INPUT connector via antenna provided, or use RF cable input with an RFA-60 attenuator in the line (see paragraph 4.4.1 or 4.4.2).

d. Set other controls as follows:

VERT IN	INT
10 MHz	OUT
DEV RANGE	As required

e. Key transmitter (do not modulate).

f. Increase RF input until OPER indicator lights.

g. If OVLD indicator lights, decrease RF input until OPER indicator lights and OVLD indicator goes out.

h. Adjust VERT CENTER to align trace in center of CRT.

j. Modulate transmitter by voice or tone.

NOTE: A 1-kHz note, variable from 0-1 V rms, is available at AUDIO OUT.

k. Adjust SWEEP RANGE and SWEEP SPEED controls for number of cycles to be displayed.

l. Use appropriate kHz scale on CRT to measure peak height of wave. Check waveform visually for presence of distortion.

m. Monitor modulation aurally by adjusting VOLUME control to desired listening level.

n. To investigate audio distortion further, connect a Distortion Analyzer to DIST ANAL output.

4.14 AUDIO TEST TONE GENERATION (MAINFRAME/ODM-1)

NOTE: The 1 kHz modulation tone developed by Mainframe/ ODM-1 is available at all times at the AUDIO OUT connector for testing of transmitters and repeaters.

a. Connect transmitter microphone input to AUDIO OUT.

b. Turn INT MOD/AUDIO OUT control to level desired (a maximum of 1 V rms into 600 ohms is available).

c. The Mainframe/ODM-1 is now supplying a 1 kHz tone with 600 ohms output impedance.

4.15 GENERAL PURPOSE OSCILLOSCOPE (MAINFRAME/OAM-1)

The OAM-1 is used as a general purpose oscilloscope with the horizontal sweep generated either internally or externally.

4.15.1 INTERNAL HORIZONTAL SWEEP.

a. Set MOD MODE switch at either INT or EXT.

b. Set VERT MODE switch at EXT.

c. For maximum sensitivity turn VERT GAIN control fully CW.

d. Connect signal to be displayed on CRT to the VERT IN connector.

NOTE: The nominal frequency response to the vertical amplifier is 50 Hz to 30 kHz.

e. Adjust VERT GAIN control for suitable trace height.

f. Set SWEEP RANGE switch at HI or LO for coarse adjustment of horizontal display.

g. Adjust SWEEP SPEED control for number of displayed cycles.

4.15.2 EXTERNAL HORIZONTAL SWEEP.

a. Set MOD MODE switch at EXT HORIZ.

b. Connect an external sweep source to EXT MOD/HORIZ IN connector and adjust for desired oscilloscope sweep width (less than 175 mV rms per inch of deflection).

c. Set VERT MODE switch at EXT.

d. For maximum sensitivity, turn VERT GAIN control fully CW.

e. Connect signal to be displayed on CRT to VERT IN connector.

NOTE: The nominal frequency response to the vertical amplifier is 50 Hz to 30 kHz.

f. Adjust VERT GAIN control for suitable trace height.

4.15.3 X-Y MODE OF OPERATION.

In some applications, it is desirable to display one signal versus another (X-Y) rather than against time (internal or external sweep).

a. Set VERT MODE switch at EXT.

b. Set MOD MODE switch at EXT HORIZ.

c. Apply signal for X-axis display to EXT MOD/HORIZ IN connector.

d. Apply signal for Y-axis display to VERT IN connector.

e. Adjust VERT GAIN control for suitable trace height.

f. Adjust X-axis signal level externally for desired trace width (less than 175 mV rms per inch width).

4.16 GENERAL PURPOSE OSCILLOSCOPE (MAINFRAME/ODM-1)

The ODM-1 is used as a general purpose oscilloscope with the horizontal sweep generated either internally or externally.

4.16.1 INTERNAL HORIZONTAL SWEEP.

a. Set VERT IN switch at EXT.

b. For maximum sensitivity turn VERT GAIN control fully CW.

c. Connect signal to be displayed on CRT to VERT IN connector (signal must be within 50-Hz to 30-kHz range).

d. Set MOD MODE switch at INT/COMB or EXT.

e. Adjust VERT GAIN control for suitable trace height.

f. Set SWEEP RANGE switch at HI or LO for coarse adjustment of horizontal display.

g. Adjust SWEEP SPEED control for desired number of displayed cycles.

4.16.2 EXTERNAL HORIZONTAL SWEEP.

a. Repeat 4.16.1 except set MOD MODE switch at EXT HORIZ.

b. Connect EXT MOD/HORIZ IN to external sweep signal source and adjust amplitude for desired sweep width (less than 175 mV rms per inch width).

4.16.3 X-Y MODE OF OPERATION.

In some applications, it is desirable to display one signal versus another (X-Y) rather than against time (internal or external sweep).

a. Set VERT MODE switch at EXT.

b. Set MOD MODE switch at EXT HORIZ.

c. Apply signal for x-axis display to EXT MOD/HORIZ IN connector.

d. Apply signal for y-axis display to VERT IN connector.

e. Adjust VERT GAIN control for suitable trace height.

f. Adjust x-axis signal level externally for desired trace width (less than 175 mV rms per inch width).

APPENDIX A

SECOND HARMONIC INFORMATION

The second harmonic of the FM-2748 from 250 MHz to 500 MHz is between 25 to 40 dB down at the RF OUTPUT connector. It is not calibrated and will vary between units.

To measure frequencies from 500 MHz to 1 GHz set the FM-2748 frequency to one-half the frequency to be measured. To measure FM or AM modulation of frequencies from 500 MHz to 999 MHz set the FM-2748 frequency to one-half plus 1 MHz of the frequency to be measured. Use minus 1 MHz for frequencies from 999 MHz to 1 GHz.

The measure input sensitivity for frequencies from 500 MHz to 1 GHz will vary from 60 millivolts to 230 millivolts.

For FM generate, the peak deviation of the second harmonic will be twice that of the fundamental.

For AM generate, the percent modulation of the second harmonic has no real relation to the percent modulation of the fundamental; therefore it cannot be predicted.

ADDENDUM
for
MODEL FM-2748/ODM-1

Manual No. 500783-250

Page 2-4 MEASUREMENT ACCURACY

Delete: Generator (A2,A3)

Add: Internal time base (see frequency accuracy under "Generator Functions" in this table).

Page 2-5 Table 2-1, Specifications (cont.)

After FREQUENCY MODULATION MONITOR FUNCTION,

Add: (with ODM-1)

After Sensitivity for Operate light,

Add: Sensitivity for overload light: 20 dB ±3 dB above "operate" sensitivity,

Page 2-6 OSCILLOSCOPE FUNCTIONS (ODM-1) Vertical Amplifier Sensitivity:

Delete: "in 1.5 kHz range"

OSCILLOSCOPE FUNCTIONS (ODM-1) Horizontal Amplifier Input Impedance:

Add: >

Page 3-6 TABLE 3-1, MAINFRAME CONTROLS AND INDICATORS

Pin 11	Was:	75 mV rms ±20%
	Is:	75 mV rms ±10%
Pin 12	Was:	80 mV rms ±10% (2 places)
	Is:	100 mV rms ±5% (2 places)

Page 3-12 At the end of table, add:

Rear panel
Connector P1 16 pin plug

Pin #2: Chassis Ground
Pin #3: Cable Shield for Pin #11.
Pin #6: Cable Shield for Pin #14.
Pin #8: Cable Shield for Pin #16.
Pin #9: +9V dc ±10% at 900 mA Max. (regulated
Pin #11: Audio modulation signal to AM modulator in mainframe. 80 mV rms minimum with R2 full CW and S-6 in Int. position. With S-6 in Ext. position, level is proportional to level applied to J4, (15 mV ±5% for 100 mV rms at J4). Output impedance 10Ω ±20%.

Revision	Initials	Date	Approved

SINGER INSTRUMENTATION LOS ANGELES, CALIF.	TITLE ADDENDUM MODEL FM-2748 / ODM-1	DWG NO. I- 500783-250 SHEET 1.1

FORM NO. 160 1M 3-70 D-H

Pin #14:		Recovered audio out to audio amplifier mainframe. Output impedance 120 Ω ±20% at 1 kHz with level proportional to % of modulation. 100 mV rms ±10% for full-scale modulation, i.e., 30% and 100%.

Page 3-17, Table 3-3, ODM-1, Controls and Indicators

Pin 12:	Was:	200Ω ±20%
	Is:	Less than 100Ω
	Was:	400 mV rms with 400 mV rms into....
	Is:	500 mV rms ±5% with 400 mV rms into....
	Was:	2k Load
	Is:	5.6k Ω Load

Page 4-4, Fig. 4-2

Under RFA-60,	Add:	an Asterisk
Below transmitter block,	Add:	*Frequency response of RFA-60 is 150 - 160 MHz

Page 4-7

4.6.1.a	Was:	12.000 MHz
	Is:	8.000 MHz

Page 4-9

4.8.1.a NOTE:	Was:	0-1 MHz
	Is:	0-1 kHz

Page 4-11

4.8.4.c, Frequency Controls		
	Was:	008.000 MHz
	Is:	008.V00 MHz (wideband deviation) 008.0V0 MHz (narrowband deviation)
Below INT MOD/AUDIO OUT,	Add:	"Note: Ensure that the 0-1 kHz frequency control is not at the OUT position"
4.14.2.a	Was:	Repeat 4.18.1
	Is:	Repeat 4.14.1

Page 4-17

4.14.1.b	Delete:	"with DEV RANGE switch set at 1.5kHz"
4.14.1.4	Delete:	"and DEV RANGE switch"

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SINGER INSTRUMENTATION LOS ANGELES, CALIF.	TITLE ADDENDUM MODEL FM-2748 / ODM-1	DWG NO. I-500783-250 SHEET 2

FORM NO. 160 TM 3-70 D-H

OAM-1 RUNNING CHANGES

Effective serial number: OAM-1 serial numbers prefixed with 566 and above.

Page 2-2: TABLE 2-1. SPECIFICATIONS

Amplitude modulation (with OAM-1 plug-in)

INT, Add: 30 to 100% at 10% maximum distortion

EXT, Was: 30-50% at 10% maximum distortion. Is: 30-100% at 10% maximum distortion

Page 2-4: TABLE 2-1. SPECIFICATIONS (CONT)

AMPLITUDE MODULATION MONITOR FUNCTION (WITH OAM-1)

Ranges, Delete: (useable to 95%)

Page 3-8: Figure 3-2. OAM-1 Front Panel

RANGE, Was: GEN 30%, 30%, 100% Is: GEN 30%, MEAS 30 %, MEAS/GEN 100%

Page 3-9: TABLE 3-2. OAM-1 CONTROLS AND INDICATORS

Item 2, RANGE, Was: GEN 30 %, 30%, 100% Is: GEN 30%, MEAS 30%, MEAS/GEN 100%

Function, 100% position, Add: Provides internal or external amplitude modulation of the mainframe carrier up to 100 %.

Page 4-7: Paragraph 4.6.1 INTERNAL MODULATION

g., delete the period and Add: for up to 30 % modulation or set it to MEAS/GEN 100% for greater than 30% modulation.

Page 4-8: Paragraph 4.6.2

h., delete the period and Add: for up to 30% modulation or set it to MEAS/GEN 100% for greater than 30% modulation.

l., lines 3 and 4, Was: "...source level by 125 mV rms produces approximately 50% modulation..."

Is: "...source level to approximately 1.7 V rms produces 100% modulation..."

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CLASS CODE		
SINGER INSTRUMENTATION LOS ANGELES, CALIF.	TITLE ADDENDUM MODEL FM-2748/ODM-1	DWG NO. I-500783-250 SHEET 2.2.1

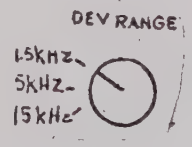
FORM NO. 160 1M 3-70 D-H

ODM-1 RUNNING CHANGES

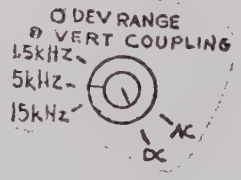
Effective ODM-1 Serial Number: Serial numbers suffixed with 04058 and above.

Page 3-13: Figure 3-3. ODM-1 Front Panel

7, Was:



Is:



8, Was:

Is:

Page 3-15: TABLE 3-3. ODM-1 CONTROLS AND INDICATORS (CONT)

Item 7, Was:	DEV RANGE 1.5 kHz 5 kHz 15 kHz	Is:	DEV RANGE (Outer knob) 1.5 kHz 5 kHz 15 kHz
Item 7, Add:	VERT COUPLING (Inner knob) AC DC	Switch, two position	Selects ac or dc coupling to the VERT IN jack. AC is used for general operation and DC is primarily designed for calibration purposes.
Item 8, Was:	MOD MODE	Is:	MOD MODE (Outer knob)
Item 8, Add:	DC BAL (Inner knob)	Variable resistor	Varies the dc balance of the FM discriminator when making direct coupled measurements. The DC BAL control affects the trace position only wher the VERT IN switch is in the INT position and the VERT COUPLING switch is in the DC position.

Pages 4-8 thru 4-11: Paragraph 4.7 thru 4.9. ODM-1 control positions, Add: VERT COUPLING AC

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Page 4-14: MEASUREMENT OF PEAK DEVIATION

Step d, Add: VERT COUPLING DC

DC BAL mid-range

Delete: Step h and add the following:

Set the VERT IN switch to EXT and verify that, without an input signal, the trace is positioned on the graticule zero line. Vary the VERT CENTER control as necessary to position the trace. Set the VERT IN switch to INT. Set the mainframe 10 MHz switch to IN and the frequency dials to 8.000 MHz. Vary the DC BAL control to center the trace on the graticule zero line. The trace position should not shift with changes in the DEV RANGE switch position. If the trace does shift, vary the VERT CENTER and DC BAL controls to reposition the trace.

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